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MM      MM      TTTTTTTTTT  HH      HH  DDDDDDDD  LL      000000  GGGGGGGG
MM      MM      TTTTTTTTTT  HH      HH  DDDDDDDD  LL      000000  GGGGGGGG
MMM     MMM     TT          HH      HH  DD      DD  LL      00      GG      GGGGGGGG
MMM     MMM     TT          HH      HH  DD      DD  LL      00      GG      GGGGGGGG
MM      MM      TT          HH      HH  DD      DD  LL      00      GG      GGGGGGGG
MM      MM      TT          HH      HH  DD      DD  LL      00      GG      GGGGGGGG
MM      MM      TT          HH      HH  DD      DD  LL      00      GG      GGGGGGGG
MM      MM      TT          HH      HH  DD      DD  LL      00      GG      GGGGGGGG
MM      MM      TT          HH      HH  DD      DD  LL      00      GG      GGGGGGGG
MM      MM      TT          HH      HH  DD      DD  LL      00      GG      GGGGGGGG
MM      MM      TT          HH      HH  DDDDDDDD  LLLLLLLLLL  000000  GGGGGG  ....
MM      MM      TT          HH      HH  DDDDDDDD  LLLLLLLLLL  000000  GGGGGG  ....
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LL      IIIIII  SSSSSSSS
LL      IIIIII  SSSSSSSS
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LL      II      SS
LL      II      SS
LL      II      SS
LL      II      SS
LLLLLLLL  IIIIII  SSSSSSSS
LLLLLLLL  IIIIII  SSSSSSSS
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(2) 61
(3) 95
(4) 277
(5) 359
(6) 395
(7) 432

HISTORY : Detailed Current Edit History
DECLARATIONS ; Declarative Part of Module
MTH\$DLOG - Standard Double Precision Floating DLOG
MTH\$DLOG10 - Standard Single Precision Floating Common log
MTH\$DLOG2 - Standard Single Precision Floating Common logarithm
MTH\$DLOGDLOG10_R8 - Special DLOG/DLOG10 routines


```
0000 1 .TITLE MTH$DLOG ; Floating Point Natural and Common
0000 2 ; Logarithm Functions (DLOG,DLOG10)
0000 3 .IDENT /2-003/ ; File: MTHDLOG.MAR Edit: PDG2003
0000 4 :
0000 5 :*****
0000 6 :*
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0000 23 :* SOFTWARE ON EQUIPMENT WHICH IS NOT SUPPLIED BY DIGITAL.
0000 24 :*
0000 25 :*
0000 26 :*****
0000 27 :
0000 28 :
0000 29 : FACILITY: MATH LIBRARY
0000 30 :++
0000 31 : ABSTRACT:
0000 32 :
0000 33 : MTH$DLOG and MTH$DLOG10 are functions which return the double precision
0000 34 : floating point natural or common logarithm of their double precision
0000 35 : floating point argument. The call is standard call-by-reference.
0000 36 : MTH$DLOG_R8 and MTH$DLOG10_R8 are special routines which are the same
0000 37 : as MTH$DLOG and MTH$DLOG10 except a faster non-standard JSB call is
0000 38 : used with the argument in R0 and no registers are saved.
0000 39 :
0000 40 :--
0000 41 :
0000 42 : VERSION: 01
0000 43 :
0000 44 : HISTORY:
0000 45 : AUTHOR:
0000 46 : Peter Yuo, 15-Oct-76: Version 01
0000 47 :
0000 48 : MODIFIED BY:
0000 49 :
0000 50 : 01-1 Peter Yuo, 22-May-77
0000 51 :
0000 52 : VERSION: 02
0000 53 :
0000 54 : HISTORY:
0000 55 : AUTHOR:
0000 56 : Bob Hanek, 18-Jun-81: Version 02
0000 57 :
```


MTH\$DLOG
2-003

; Floating Point Natural and Common ^{F 7}

16-SEP-1984 01:17:58 VAX/VMS Macro V04-00
6-SEP-1984 11:22:15 [MTHRTL.SRC]MTHDLOG.MAR;1

Page 2
(1)

0000 58 ;
0000 59 ;

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0000 61      .SBTTL HISTORY ; Detailed Current Edit History
0000 62
0000 63
0000 64 : ALGORITHMIC DIFFERENCE FROM FP-11C ROUTINE:
0000 65 : 1. Uses POLYD so greater accuracy.
0000 66
0000 67 : Edit History for Version 01 of MTH$DLOGDLOG10
0000 68
0000 69 : 01-2 May 20, 1977 P. Yuo
0000 70 : Multiplication of EXPONENT(X) by ln(2) is done after POLY instead of
0000 71 : before, so one less register is used.
0000 72 : 01-4 May 22, 1977 P. Yuo
0000 73 : Code saving after code review
0000 74 : 01-6 MTH$ERROR changed to MTH$SIGNAL.
0000 75 : MTH$... changed to MTH...
0000 76 : Changed error handling mechanism. Put error result in R0:R1 before
0000 77 : calling MTH$SIGNAL in order to allow user modify error result.
0000 78 : 01-8 Add Rich Lary's code bums for speed... JMT 26-Jan-78
0000 79 : 01-9 Move .ENTRY mask definition to module header. TNH 14-Aug-78
0000 80 : 1-010 - Update version number and copyright notice. JBS 16-NOV-78
0000 81 : 1-011 - Change MTH_LOGZEREG to MTH$K_LOGZERNEG. JBS 07-DEC-78
0000 82 : 1-012 - Add " " to the PSECT directive. JBS 22-DEC-78
0000 83 : 1-013 - Add comment explaining code trickery. SBL 14-Feb-1979
0000 84 : 1-014 - Declare externals. SBL 17-May-1979
0000 85
0000 86
0000 87 : Edit History for Version 02 of MTH$DLOGDLOG10
0000 88
0000 89
0000 90 : 2-001 - Add MTH$DLOG2. RNH 08-Aug-1981
0000 91 : 2-002 - Correct entry logic for JSB entries. Use G^ addressing for
0000 92 : externals. SBL 24-Aug-1981
0000 93 : 2-003 - Change D_FHI to the global symbol MTH$AB_D_FHI. PDG 3-Nov-81
```

```
0000 95      .SBTTL  DECLARATIONS      ; Declarative Part of Module
0000 96
0000 97 :
0000 98 : INCLUDE FILES:      MTHJACKET.MAR
0000 99 :
0000 100
0000 101 :
0000 102 : EXTERNAL SYMBOLS:
0000 103 :
0000 104      .DSABL  GBL
0000 105      .EXTRN  MTH$K_LOGZERNEG
0000 106      .EXTRN  MTH$$SIGNAL
0000 107      .EXTRN  MTH$$AB_ALOG
0000 108
0000 109 :
0000 110 : EQUATED SYMBOLS:
0000 111
0000 112      ACMASK = ^M<IV, R2, R3, R4, R5, R6, R7, R8>
0000 113      ; register save mask and IV enable
0000 114      SD_1      =      ^F1.0      ; short floating literal 1.0
0000 115
0000 116 :
0000 117 : MACROS:      none
0000 118 :
0000 119 : PSECT DECLARATIONS:
0000 120
0000 121      .PSECT  _MTH$CODE      PIC,SHR,LONG,EXE,NOWRT
0000 122      ; program section for math routines
0000 123 :
0000 124 : OWN STORAGE: none
0000 125 :
0000 126 : CONSTANTS:
0000 127 :
0000 128 :
0000 129 :
0000 130 : The D_FHI table is accessed by an index obtained from the MTH$$AB_ALOG
0000 131 : table. The MTH$$AB_ALOG table is located in MTHALOG.MAR. Indices
0000 132 : between 0 and 13 inclusive are used to access entries 0 through 13
0000 133 : respectively. For these indices, the first three items of the
0000 134 : corresponding entry are FHI, LN_FHI_LO and LN_FHI_HI. The last two
0000 135 : items for these entries are not used. Indices between 14 and 27
0000 136 : inclusive access entries 13 through 0 respectively. For these indices,
0000 137 : the last three items in the corresponding entry are LN_FHI_HI, LN_FHI_LO
0000 138 : and FHI. The first two items for these entries are not used.
0000 139 :
0000 140
0000 141 MTH$$AB_D_FHI::
0000 142 : Entry 0
0000 143      .QUAD  ^X000000004F9040ED      ; .18539905548095703E+01
0000 144      .QUAD  ^X7C182E8EB8ED339C      ; .18244885037187055E-07
0000 145      .QUAD  ^X0000789E0A04401E      ; .61734035439258150E+00
0000 146      .QUAD  ^X81067183B292339C      ; .18241995369217608E-07
0000 147      .QUAD  ^X00000000149E400A      ; .53937709331512451E+00
0000 148 : Entry 1
0000 149      .QUAD  ^X000000001D4340CF      ; .16180804967880249E+01
0000 150      .QUAD  ^X3D2E5B7AD371B40F      ; -.33487088150728428E-07
0000 151      .QUAD  ^X60000B76652B3FF6      ; .48124060168191818E+00
```


0B9C4628	D935B40F	0040	152	.QUAD	*X0B9C4628D935B40F	: -.33492331660229068E-07
00000000	364F401E	0048	153	.QUAD	*X00000000364F401E	: .61801618337631226E+00
		0050	154	: Entry 2		
00000000	68D440BA	0050	155	.QUAD	*X0000000068D440BA	: .14563241004943848E+01
A61156F1	0CD33306	0058	156	.QUAD	*XA61156F10CD33306	: .78027427538038965E-08
60008AC0	77FF3FC0	0060	157	.QUAD	*X60008AC077FF3FC0	: .37591551369422405E+00
CDAD85CD	A4CC3306	0068	158	.QUAD	*XCDAD85CDA4CC3306	: .78372974978005425E-08
00000000	C8F9402F	0070	159	.QUAD	*X00000000C8F9402F	: .68666034936904907E+00
		0078	160	: Entry 3		
00000000	AD1D40AB	0078	161	.QUAD	*X00000000AD1D40AB	: .13412204980850220E+01
0E198034	C7A5B262	0080	162	.QUAD	*X0E198034C7A5B262	: -.33000814305226938E-08
4000E416	501E3F96	0088	163	.QUAD	*X4000E416501E3F96	: .29358002218498314E+00
4E4F98EB	E03AB262	0090	164	.QUAD	*X4E4F98EBE03AB262	: -.33014787786590467E-08
00000000	DEF5403E	0098	165	.QUAD	*X00000000DEF5403E	: .74558955430984497E+00
		00A0	166	: Entry 4		
00000000	1DA240A1	00A0	167	.QUAD	*X000000001DA240A1	: .12587168216705322E+01
CD6919A2	775532F6	00A8	168	.QUAD	*XCD6919A2775532F6	: .71731088180994794E-08
8000616B	9D723F6B	00B0	169	.QUAD	*X8000616B9D723F6B	: .23009279937366500E+00
C455AB15	49CA32F6	00B8	170	.QUAD	*XC455AB1549CA32F6	: .71679314343157716E-08
00000000	61B9404B	00C0	171	.QUAD	*X0000000061B9404B	: .79445987939834595E+00
		00C8	172	: Entry 5		
00000000	8BD24099	00C8	173	.QUAD	*X000000008BD24099	: .11995794773101807E+01
670D0B74	F961339A	00D0	174	.QUAD	*X670D0B74F961339A	: .18041364037815043E-07
4000E4BA	569D3F3A	00D8	175	.QUAD	*X4000E4BA569D3F3A	: .18197104176084622E+00
FFFF96B7	FE36339A	00E0	176	.QUAD	*XFFFF96B7FE36339A	: .18043562357555396E-07
00000000	687B4055	00E8	177	.QUAD	*X00000000687B4055	: .83362549543380737E+00
		00F0	178	: Entry 6		
00000000	FFA64093	00F0	179	.QUAD	*X00000000FFA64093	: .11562392711639404E+01
A6B0F8DA	A4AF33D2	00F8	180	.QUAD	*XA6B0F8DAA4AF33D2	: .24522108738420825E-07
A0006714	A8273F14	0100	181	.QUAD	*XA0006714A8273F14	: .14517270628599022E+00
B4C359CD	AACF33D2	0108	182	.QUAD	*XB4C359CDAACF33D2	: .24524892962309998E-07
00000000	6850405D	0110	183	.QUAD	*X000000006850405D	: .86487293243408203E+00
		0118	184	: Entry 7		
00000000	C18C408F	0118	185	.QUAD	*X00000000C18C408F	: .11230940818786621E+01
EE2F7A5B	B6A5330E	0120	186	.QUAD	*XEE2F7A5BB6A5330E	: .83070168326007080E-08
A0009BED	BF403EED	0128	187	.QUAD	*XA0009BEDBF403EED	: .11608744121413395E+00
20E25DDF	AD3A330E	0130	188	.QUAD	*X20E25DDFAD3A330E	: .83048753355949145E-08
00000000	F1154063	0138	189	.QUAD	*X00000000F1154063	: .89039736986160278E+00
		0140	190	: Entry 8		
00000000	5B39408C	0140	191	.QUAD	*X000000005B39408C	: .10965338945388794E+01
C08B3EA8	8FDBB3B1	0148	192	.QUAD	*XC08B3EA88FDBB3B1	: -.20670930291477513E-07
A0001EBC	BB5A3EBC	0150	193	.QUAD	*XA0001EBCBB5A3EBC	: .92154220641148754E-01
D0AD3C6F	7941B3B1	0158	194	.QUAD	*XD0AD3C6F7941B3B1	: -.20660652275383675E-07
00000000	76814069	0160	195	.QUAD	*X0000000076814069	: .91196447610855103E+00
		0168	196	: Entry 9		
00000000	B2B24089	0168	197	.QUAD	*X00000000B2B24089	: .10757658481597900E+01
5EC72E37	64A1340B	0170	198	.QUAD	*X5EC72E3764A1340B	: .32454981566347323E-07
80007615	92373E95	0178	199	.QUAD	*X8000761592373E95	: .73032792369019717E-01
7ACE3A06	5ACA340B	0180	200	.QUAD	*X7ACE3A065ACA340B	: .32446032444473518E-07
00000000	F853406D	0188	201	.QUAD	*X00000000F853406D	: .92957037687301636E+00
		0190	202	: Entry 10		
00000000	B4DF4087	0190	203	.QUAD	*X00000000B4DF4087	: .10602072477340698E+01
26F6B5B8	ADAD33B9	0198	204	.QUAD	*X26F6B5B8ADAD33B9	: .21615814400350767E-07
60009CEF	78593E6F	01A0	205	.QUAD	*X60009CEF78593E6F	: .58464384127510982E-01
E061C397	B27D33B9	01A8	206	.QUAD	*XE061C397B27D33B9	: .21618002968246588E-07
00000000	76554071	01B0	207	.QUAD	*X0000000076554071	: .94321185350418091E+00
		01B8	208	: Entry 11		

```
00000000 54244086 01B8 209 .QUAD ^X0000000054244086 : .10494427680969238E+01
E9F0E38D B48AB412 01C0 210 .QUAD ^XE9F0E38DB48AB412 : -.34157476452222763E-07
A0006AC5 AB9B3E45 01C8 211 .QUAD ^XA0006AC5AB9B3E45 : .48259360406838425E-01
437DC492 B075B412 01D0 212 .QUAD ^X437DC492B075B412 : -.34153763436452798E-07
00000000 F0604073 01D8 213 .QUAD ^X00000000F0604073 : .95288658142089844E+00
01E0 214 ; Entry 12
00000000 38494085 01E0 215 .QUAD ^X0000000038494085 : .10407801866531372E+01
AE5B4241 5CE33328 01E8 216 .QUAD ^XAE5B42415CE33328 : .98000072579782171E-08
A000A9A3 B8363E23 01F0 217 .QUAD ^XA000A9A3B8363E23 : .39970601583469545E-01
D4DA866C 39CC3328 01F8 218 .QUAD ^XD4DA866C39CC3328 : .97920289877412402E-08
00000000 F8264075 0200 219 .QUAD ^X00000000F8264075 : .96081769466400146E+00
0208 220 ; Entry 13
00000000 6EE94084 0208 221 .QUAD ^X000000006EE94084 : .10346347093582153E+01
5D360D07 4E8B3345 0210 222 .QUAD ^X5D360D074E8B3345 : .11484767848640602E-07
6000D68B 76593E0B 0218 223 .QUAD ^X6000D68B76593E0B : .34048415117204911E-01
281BA6FA 33443345 0220 224 .QUAD ^X281BA6FA33443345 : .11478566232851673E-07
00000000 6E2A4077 0228 225 .QUAD ^X000000006E2A4077 : .96652472019195557E+00
0230 226
0230 227 ;
0230 228 ; Polynomial constants tables
0230 229 ;
0230 230
0230 231 LOGTAB1: ; Constants for q(z). Generated using
0230 232 ; eq. 6.3.10 of Hart et. al. (sin(2a)
0230 233 ; = 1/32)
1E51DE52 4D00BECD 0230 234 .QUAD ^X1E51DE524D00BECD : C9 = -0.10024452856511271
44C1F2BD 0E683EE4 0238 235 .QUAD ^X44C1F2BD0E683EE4 : C8 = 0.11135560980588577
9B9BEC78 FFD8BEFF 0240 236 .QUAD ^X9B9BEC78FFD8BEFF : C7 = -0.12499973121073342
4BB28A46 49143F12 0248 237 .QUAD ^X4BB28A4649143F12 : C6 = 0.14285690397225510
6C93AD01 AAAABF2A 0250 238 .QUAD ^X6C93AD01AAAABF2A : C5 = -0.16666666680280835
C92CCE8D CCCC3F4C 0258 239 .QUAD ^XC92CCE8DCCCC3F4C : C4 = 0.20000000010208756
DCE9FFFF FFFFBF7F 0260 240 .QUAD ^XDCE9FFFFFFFFFFBF7F : C3 = -0.24999999999996883
A0A5AAAA AAAA3FAA 0268 241 .QUAD ^XA0A5AAAAAAA3FAA : C2 = 0.333333333333331553
00000000 0000C000 0270 242 .QUAD ^X000000000000C000 : C1 = -0.50000000000000000
00000000 00000000 0278 243 .QUAD ^X0000000000000000 : C0 = 0.00000000000000000
0000000A 0280 244 LOGLEN1 = .-LOGTAB1/8 ; no. of floating point entries
0280 245
0280 246
0280 247 LOGTAB2: ; Constants for p(z*z). Generated using
0280 248 ; eq. 6.3.11 of Hart et. al. (sin(2a) =
0280 249 ; (b - 1)/(b + 1) where b = 2**(1/7))
88B900ED 70B23F3B 0280 250 .QUAD ^X88B900ED70B23F3B : C5 = 0.183047086054451500
5D2C3E00 8D3C3F63 0288 251 .QUAD ^X5D2C3E008D3C3F63 : C4 = 0.222218457493082486
185BC1CE 49243F92 0290 252 .QUAD ^X185BC1CE49243F92 : C3 = 0.285714291246265538
1CEFCCC4 CCCC3FCC 0298 253 .QUAD ^X1CEFCCC4CCCC3FCC : C2 = 0.3999999999996049620
AB02AAAA AAAA402A 02A0 254 .QUAD ^XAB02AAAAAAA402A : C1 = 0.666666666666667879
00000000 00004100 02A8 255 .QUAD ^X0000000000004100 : C0 = 2.000000000000000000
00000006 02B0 256 LOGLEN2 = .-LOGTAB2/8
02B0 257
02B0 258
02B0 259
02B0 260 ;+ The "128" in the constants is used to shift the unbiased exponent
02B0 261 ; right 7 places so that the rightmost bit is at bit 0.
02B0 262 ;-
02B0 263
02B0 264 D_LN_2_HI:
7200F7B1 72173CB1 02B0 265 .QUAD ^X7200F7B172173CB1 ; (Hi 48 bits of ln2)/128
```


8ECEAF27 75E62B81	02B8	266	D_LN_2_LO:		
	02B8	267	.QUAD	^X8ECEAF2775E62B81	: (Low bits of ln2)/128
	02C0	268	D_DLOG10_E:		: LOG10(e)
5BD8 3FDE	02C0	269	.WORD	^0037736,^0055730	
2872 A937	02C4	270	.WORD	^0124467,^0024162	
	02C8	271	D_INV_LN2	CONS:	: convert natural log to log base 2
17F1295C AA3B40B8	02C8	272	.DOUBLE	1.4426950408889634073599246810018921374266	
	02D0	273			
	02D0	274			
	02D0	275			


```
02D0 277 .SBTTL MTH$DLOG - Standard Double Precision Floating DLOG
02D0 278
02D0 279
02D0 280 :++
02D0 281 : FUNCTIONAL DESCRIPTION:
02D0 282 :
02D0 283 : DLOG - single precision floating point function
02D0 284 :
02D0 285 : DLOG(X) is computed using the following approximation technique:
02D0 286 :
02D0 287 : If X =< 0, error. Otherwise
02D0 288 :
02D0 289 : Let X = f * (2**n), where 1/2 <= f < 1
02D0 290 :
02D0 291 : If n is greater than or equal to 1 than
02D0 292 :   set N = n - 1 and F = 2*f.
02D0 293 : Else
02D0 294 :   set N = n and F = f.
02D0 295 :
02D0 296 : Then ln(x) = N*ln2 + ln(F)
02D0 297 :
02D0 298 : If |F - 1| < 2**-5 then
02D0 299 :   ln(F) = W + W*P(W), where W = F - 1 and P
02D0 300 :   is a polynomial of degree 8.
02D0 301 : Else
02D0 302 :   ln(F) = ln(FHI) + Z*Q(Z*Z), where FHI is ob-
02D0 303 :   tained by table look-up, Q is a polynomial of
02D0 304 :   degree 5 and Z = (F - FHI)/(F + FHI)
02D0 305 :
02D0 306 : NOTE: The quantities ln(FHI) and ln2 are used in the above
02D0 307 : equations in two parts - a high part (containing the
02D0 308 : high order bits) and a low part (containing the low
02D0 309 : order bits. In the code the high and low parts of the
02D0 310 : constants are indicated by a HI and LO suffix respec-
02D0 311 : tively. The values were chosen such that N*LN_2_HI +
02D0 312 : LN_FHI_HI is exactly representable.
02D0 313 :
02D0 314 :
02D0 315 : CALLING SEQUENCE:
02D0 316 :
02D0 317 :   logarithm.wd.v = MTH$DLOG(x.rd.r)
02D0 318 :
02D0 319 : INPUT PARAMETERS:
02D0 320 :
02D0 321 :   LONG = 4 ; define longword multiplier
02D0 322 :   x = 1 * LONG ; Contents of x is the argument
02D0 323 :
02D0 324 : IMPLICIT INPUTS: none
02D0 325 :
02D0 326 : OUTPUT PARAMETERS:
02D0 327 :
02D0 328 :   VALUE: double precision floating logarithm of the argument
02D0 329 :
02D0 330 : IMPLICIT OUTPUTS: none
02D0 331 :
02D0 332 : COMPLETION CODES: none
02D0 333 :
```

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00000004

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02D0 334 : SIDE EFFECTS:
02D0 335 :
02D0 336 : Signals: MTH$_LOGZERNEG if !X! =< 0.0 with reserved operand in R0/R1
02D0 337 : (copied to the signal mechanism vector CHF$_MCH_R0/R1 by LIB$SIGNAL).
02D0 338 : Associated message is: "LOGARITHM OF ZERO OR NEGATIVE VALUE". Result is
02D0 339 : reserved operand -0.0 unless a user supplied (or any) error handler changes
02D0 340 : CHF$_MCH_R0/R1.
02D0 341 :
02D0 342 : NOTE: This procedure disables floating point underflow, enables integer
02D0 343 : overflow, causes no floating overflow or other arithmetic traps, and
02D0 344 : preserves enables across the call.
02D0 345 :
02D0 346 :---
02D0 347 :
02D0 348 :
41FC 02D0 349 .ENTRY MTH$DLOG, ACMASK ; standard call-by-reference entry
02D2 350 ; disable DV (and FU), enable IV
02D2 351 MTH$FLAG_JACKET ; flag that this is a jacket procedure
6D 00000000'GF 9E 02D2 MOVAB G^MTH$$JACKET_HND, (FP) ; set handler address to jacket
02D9 ; handler
02D9
02D9 352 ; in case of an error in special JSB
02D9 353 ; routine
50 04 BC 70 02D9 354 MOVD @x(AP), R0 ; R0/R1 = arg
04 10 02DD 355 BSBB MTH$DLOG_R8 ; call special DLOG routine
04 04 02DF 356 RET ; return - result in R0
02E0 357
```



```

02E0 359 .SBTTL MTH$DLOG10 - Standard Single Precision Floating Common Log
02E0 360
02E0 361 :++
02E0 362 : FUNCTIONAL DESCRIPTION:
02E0 363
02E0 364 : DLOG10 - single precision floating point function
02E0 365
02E0 366 : DLOG10(X) is computed as DLOG10(E) * DLOG(X).
02E0 367
02E0 368 : See description of MTH$DLOG
02E0 369
02E0 370 : CALLING SEQUENCE:
02E0 371
02E0 372 : logarithm_base_10.wd.v = MTH$DLOG10(x.rd.r)
02E0 373
02E0 374 : INPUT PARAMETERS:
02E0 375
00000004 02E0 376 LONG = 4 ; define longword multiplier
00000004 02E0 377 x = 1 * LONG ; Contents of x is the argument
02E0 378
02E0 379 :
02E0 380 : SIDE EFFECTS: See description of MTH$DLOG
02E0 381
02E0 382 :--
02E0 383
02E0 384
41FC 02E0 385 .ENTRY MTH$DLOG10, ACMASK ; standard call-by-reference entry
02E2 386 ; disable DV (and FU), enable IV
02E2 387 MTH$FLAG_JACKET ; flag that this is a jacket procedure
02E2
6D 00000000'GF 9E 02E2 MOVAB G^MTH$$JACKET_HND, (FP)
02E9 ; set handler address to jacket
02E9 ; handler
02E9
02E9 388 ; in case of an error in special JSB
02E9 389 ; routine
50 04 BC 70 02E9 390 MOVD @x(AP), R0 ; R0/R1 = arg
15 10 02ED 391 BSBB MTH$DLOG10_R8 ; call special DLOG10 routine
04 04 02EF 392 RET ; return - result in R0
02F0 393

```



```

02F0 395 .SBTTL MTH$DLOG2 - Standard Single Precision Floating Common Logarithm
02F0 396
02F0 397 :++
02F0 398 : FUNCTIONAL DESCRIPTION:
02F0 399 :
02F0 400 : DLOG2 - double precision floating point function
02F0 401 :
02F0 402 : DLOG2(X) is computed as DLOG2(E) * DLOG(X).
02F0 403 :
02F0 404 : See description of MTH$DLOG
02F0 405 :
02F0 406 : CALLING SEQUENCE:
02F0 407 :
02F0 408 :     logarithm_base_2.wd.v = MTH$DLOG2(x.rd.r)
02F0 409 :
02F0 410 : INPUT PARAMETERS:
02F0 411 :
00000004 02F0 412 LONG = 4 ; define longword multiplier
00000004 02F0 413 x = 1 * LONG ; Contents of x is the argument
02F0 414 :
02F0 415 :
02F0 416 : SIDE EFFECTS: See description of MTH$DLOG
02F0 417 :
02F0 418 :--
02F0 419 :
02F0 420 :
02F0 421 .ENTRY MTH$DLOG2, ACMASK ; standard call-by-reference entry
02F2 422 MTH$FLAG_JACKET ; disable DV (and FU), enable IV
02F2 423 ; flag that this is a jacket procedure
6D 00000000'GF 9E 02F2 MOVAB G^MTH$$JACKET_HND, (FP) ; set handler address to jacket
02F9 ; handler
02F9
02F9 424 ; in case of an error in special JSB
02F9 425 ; routine
50 04 BC 70 02F9 426 MOVD @x(AP), R0 ; R0/R1 = arg
50 04 BC 70 02F9 427 BSBB MTH$DLOG_R8 ; JSB to natural log
50 C6 AF 64 02FF 428 MUL2 D_INV_LN2_CONS, R0 ; convert to base 2
04 0303 429 RET ; return - result in R0
0304 430

```

```
0304 432 .SBTTL MTH$DLOGDLOG10_R8 - Special DLOG/DLOG10 routines
0304 433
0304 434 ; Special DLOG/DLOG10 - used by the standard routine, and directly.
0304 435
0304 436 CALLING SEQUENCE:
0304 437 ; save anything needed in R0:R9
0304 438 MOVW R0 ; input in R0/R1
0304 439 JSB MTH$DLOG10_R8 /MTH$DLOG_R8
0304 440 ; return with result in R0/R1
0304 441 ; Note: This routine is written to avoid causing any integer overflows,
0304 442 ; floating overflows, or floating underflows or divide by 0 conditions,
0304 443 ; whether enabled or not.
0304 444
0304 445 REGISTERS USED:
0304 446 ; R0/R1 - Double floating argument then result
0304 447 ; R2/R3 - scratch
0304 448 ; R0:R5 - POLYD
0304 449 ; R6/R7 - W during POLYD
0304 450 ; R8 - Pointer into D_FHI table
0304 451
0304 452
0304 453
0304 454 MTH$DLOG10_R8::
0304 455 BICW3 #^X7F, R0, R8 ; special DLOG10 routine
0304 456 BLEQ ERR ; R8 = biased exponent
0304 457 ; Error if <= 0
0304 458 ; Note: ERROR routine depends on user
0304 459 ; PC being on top of stack, so
0304 460 ; subroutine call to MTH$DLOG_R8 is
0304 461 ; not used
0304 462 BSBB DLOG_COMMON_R8 ; call common DLOG/DLOG10 routine
0304 463 MULW D_DLOG10_E, R0 ; R0/R1 = DLOG10(e) * DLOG(X)
0304 464 RSB ; return
0304 465
0304 466 MTH$DLOG_R8::
0304 467 BICW3 #^X7F, R0, R8 ; special LOG routine
0304 468 BLEQ ERR ; R8 = Biased exponent
0304 469 ; DLOG(X) is not defined for X=<0
0304 470
0304 471 DLOG_COMMON_R8:
0304 472 SUBW #^X4000, R8 ; R8 = Unbiased exponent
0304 473 BLEQ NEG_EXP ; Branch to processing for n=<0
0304 474
0304 475 ; Exponent is positive. N = n - 1 and F = 2f
0304 476
0304 477 SUBW #^X80, R8 ; R8 = N = n - 1
0304 478 SUBW R8, R0 ; R0/R1 = F = 2f
0304 479 MOVZBL R0, R3 ; R3 = index into MTH$$AB ALOG table
0304 480 MOVW G^MTH$$AB ALOG[R3], R3 ; R3 = offset into D_FHI tables
0304 481 BLSS LN_1_PLUS ; Branch to special processing
0304 482 ; for F close to 1
0304 483
0304 484 ; Compute Z, Z**2, P(Z**2) and Z*P(Z**2)
0304 485
0304 486
0304 487 CVTWD R8, -(SP) ; Push N onto the stack
0304 488 MOVAQ MTH$$AB_D_FHI[R3], R8 ; R8 = Address of FHI
```



```
56 54 88 7D 0340 489 MOVQ (R8)+, R4 ; R4/R5 = FHI
50 54 63 0343 490 SUBD3 R4, R0, R6 ; R6/R7 = F - FHI
50 54 60 0347 491 ADDD R4, R0 ; R0/R1 = F + FHI
56 50 66 034A 492 DIVD R0, R6 ; R6/R7 = Z = (F - FHI)/(F + FHI)
56 56 65 034D 493 MULD3 R6, R6, R0 ; R0/R1 = Z**2
FF29 CF 05 50 75 0351 494 POLYD R0, #LOGLEN2-1, LOGTAB2 ; R0/R1 = P(Z**2)
50 56 64 0357 495 MULD R6, R0 ; R0/R1 = Z*P(Z**2)
035A 496
035A 497 ;
035A 498 ; Compute B = N*LN_2_LO + LN_FHI_LO + Z*P(Z*Z)
035A 499 ;
52 FF59 CF 6E 65 035A 500 MULD3 (SP), D_LN_2_LO, R2 ; R2/R3 = N*LN_2_LO
52 88 60 0360 501 ADDD (R8)+, R2 ; R2/R3 = N*LN_2_LO + LN_FHI_LO
50 52 60 0363 502 ADDD R2, R0 ; R0/R1 = B
0366 503
0366 504 ;
0366 505 ; Compute A = N*LN_2_HI + LN_FHI_HI and DLOG(X)
0366 506 ;
52 FF45 CF 8E 65 0366 507 MULD3 (SP)+, D_LN_2_HI, R2 ; R2/R3 = N*LN_2_HI
52 68 60 036C 508 ADDD (R8), R2 ; R2/R3 = A = N*LN_2_HI + LN_FHI_HI
50 52 60 036F 509 ADDD R2, R0 ; R0/R1 = A + B = DLOG(X)
05 0372 510 RSB
0373 511
0373 512 LN_1_PLUS:
0373 513 BRB LN_1_PLUS_W
0375 514
0071 31 0375 515 ERR: BRW ERROR
0378 516
0378 517 ;
0378 518 ; Exponent is negative. N = n and F = f
0378 519 ;
0378 520
50 58 A2 0378 521 NEG_EXP: SUBW R8, R0 ; R0/R1 = F = f
53 50 9A 037B 522 MOVZBL R0, R3 ; R3 = index into MTH$$AB ALOG table
00000000 GF 43 90 037E 523 MOVB G^MTH$$AB ALOG[R3], R3 ; R3 = offset into D_FHI tables
3C 19 0386 524 BLSS LN_1_PLUS_W ; Branch to special processing
0388 525 ; for F close to 1
0388 526
0388 527 ;
0388 528 ; Compute Z, Z**2, P(Z**2) and Z*P(Z**2)
0388 529 ;
0388 530
58 7E 58 6D 0388 531 CVTWD R8, -(SP) ; Push N onto the stack
FC70 CF 43 7E 0388 532 MOVAQ MTH$$AB_D_FHI[R3], R8 ; R8 = Address of FHI
56 54 68 7D 0391 533 MOVQ (R8), R4 ; R4/R5 = FHI
50 54 63 0394 534 SUBD3 R4, R0, R6 ; R6/R7 = F - FHI
50 54 60 0398 535 ADDD R4, R0 ; R0/R1 = F + FHI
56 50 66 039B 536 DIVD R0, R6 ; R6/R7 = Z = (F - FHI)/(F + FHI)
50 56 65 039E 537 MULD3 R6, R6, R0 ; R0/R1 = Z**2
FED8 CF 05 50 75 03A2 538 POLYD R0, #LOGLEN2-1, LOGTAB2 ; R0/R1 = P(Z**2)
50 56 64 03A8 539 MULD R6, R0 ; R0/R1 = Z*P(Z**2)
03AB 540
03AB 541 ;
03AB 542 ; Compute B = N*LN_2_LO + LN_FHI_LO + Z*P(Z*Z)
03AB 543 ;
52 FF08 CF 6E 65 03AB 544 MULD3 (SP), D_LN_2_LO, R2 ; R2/R3 = N*LN_2_LO
52 78 60 03B1 545 ADDD -(R8), R2 ; R2/R3 = N*LN_2_LO + LN_FHI_LO
```



```
50 52 60 03B4 546 ADDD R2, R0 ; R0/R1 = B
03B7 547
03B7 548
03B7 549 ; Compute A = N*LN_2_HI + LN_FHI_HI and DLOG(X)
03B7 550
52 FEF4 CF 8E 65 03B7 551 MULD3 (SP)+, D_LN_2_HI, R2 ; R2/R3 = N*LN_2_HI
52 52 78 62 03BD 552 SUBD -(R8), R2 ; R2/R3 = A = N*LN_2_HI + LN_FHI_HI
50 52 60 03C0 553 ADDD R2, R0 ; R0/R1 = A + B = DLOG(X)
05 03C3 554 RSB
03C4 555
03C4 556 ; Special logic for F close to 1
03C4 557
03C4 558
03C4 559
03C4 560 LN_1_PLUS W:
FE62 56 50 08 63 03C4 561 SUBD3 #SD_1, R0, R6 ; R6/R7 = W = F - 1
CF 09 56 75 03C8 562 POLYD R6, #LOGLEN1-1, LOGTAB1 ; R0/R1 = Q(W)
50 56 64 03CE 563 MULD R6, R0 ; R0/R1 = W*Q(W)
54 58 6D 03D1 564 CVTWD R8, R4 ; R4/R5 = N
52 FEDF CF 54 65 03D4 565 MULD3 R4, D_LN_2_LO, R2 ; R2/R3 = N*LN_2_LO
50 52 60 03DA 566 ADDD R2, R0 ; R0/R1 = N*LN_2_LO + W*Q(W)
50 56 60 03DD 567 ADDD R6, R0 ; R0/R1 = N*LN_2_LO + LN(F)
54 FECC CF 64 03E0 568 MULD D_LN_2_HI, R4 ; R4/R5 = N*LN_2_HI
50 54 60 03E5 569 ADDD R4, R0 ; R0/R1 = DLOG(X)
05 03E8 570 RSB
03E9 571
03E9 572 ; x <= 0.0, signal error
03E9 573
03E9 574
03E9 575 ERROR: PUSHL (SP) ; return PC from JSB routine
7E 00'8F DD 03E9 576 MOVZBL #MTH$K_LOGZERNEG, -(SP) ; condition value
50 01 0F 79 03EB 577 ASHQ #15, #T, R0 ; R0 = result = reserved operand -0.0
03F3 578 ; goes to signal mechanism vector
03F3 579 ; (CHF$MCH_R0/R1) so error handler
03F3 580 ; can modify the result.
00000000'GF 02 FB 03F3 581 CALLS #2, G^MTH$$SIGNAL ; signal error and use real user's PC
03FA 582 ; independent of CALL vs JSB
05 03FA 583 RSB ; return - R0 restored from
03FB 584 ; CHF$MCH_R0/R1
03FB 585
03FB 586
03FB 587
03FB 588 .END
```

```
ACMASK          = 000041FC
DLOG_COMMON_R8  = 0000031B R    01
D_DLOG10_E      = 000002C0 R    01
D_INV_LN2_CONS  = 000002C8 R    01
D_LN_2_HI       = 000002B0 R    01
D_LN_2_LO       = 000002B8 R    01
ERR             = 00000375 R    01
ERROR           = 000003E9 R    01
LN_1_PLUS       = 00000373 R    01
LN_1_PLUS_W     = 000003C4 R    01
LOGLEN1         = 0000000A
LOGLEN2         = 00000006
LOGTAB1         = 00000230 R    01
LOGTAB2         = 00000280 R    01
LONG            = 00000004
MTH$SAB ALOG    = ***** X    00
MTH$SAB_D_FHI   = 00000000 RG   01
MTH$SAB_JACKET_HND = ***** X    01
MTH$SAB_SIGNAL  = ***** X    00
MTH$DLOG        = 000002D0 RG   01
MTH$DLOG10      = 000002E0 RG   01
MTH$DLOG10_R8   = 00000304 RG   01
MTH$DLOG2       = 000002F0 RG   01
MTH$DLOG_R8     = 00000313 RG   01
MTH$K_LOGZERNEG = ***** X    00
NEG_EXP         = 00000378 R    01
SD_T            = 00004080
X               = 00000004
```

```
+-----+
! Psect synopsis !
+-----+
```

PSECT name	Allocation	PSECT No.	Attributes															
ABS	00000000 (0.)	00 (0.)	NOPI	USR	CON	ABS	LCL	NOSHR	NOEXE	NORD	NOWRT	NOVEC	BYTE					
MTH\$CODE	000003FB (1019.)	01 (1.)	PIC	USR	CON	REL	LCL	SHR	EXE	RD	NOWRT	NOVEC	LONG					

```
+-----+
! Performance indicators !
+-----+
```

Phase	Page faults	CPU Time	Elapsed Time
Initialization	31	00:00:00.10	00:00:00.63
Command processing	119	00:00:00.63	00:00:05.45
Pass 1	104	00:00:01.66	00:00:04.23
Symbol table sort	0	00:00:00.01	00:00:00.01
Pass 2	115	00:00:01.39	00:00:04.17
Symbol table output	4	00:00:00.03	00:00:00.04
Psect synopsis output	2	00:00:00.02	00:00:00.09
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	377	00:00:03.85	00:00:14.63

The working set limit was 1050 pages.
9323 bytes (19 pages) of virtual memory were used to buffer the intermediate code.
There were 10 pages of symbol table space allocated to hold 28 non-local and 0 local symbols.

648 source lines were read in Pass 1, producing 18 object records in Pass 2.
1 page of virtual memory was used to define 1 macro.

+-----+
! Macro library statistics !
+-----+

Macro library name

Macros defined

_S255\$DUA28:[SYSLIB]STARLET.MLB;2

0

0 GETS were required to define 0 macros.

There were no errors, warnings or information messages.

MACRO/ENABLE=SUPPRESSION/DISABLE=(GLOBAL,TRACEBACK)/LIS=LIS\$:MTHDLOG/OBJ=OBJ\$:MTHDLOG MSRC\$:MTHJACKET/UPDATE=(ENH\$:MTHJACKET)+MSRC\$:

AH-BT13A-SE
VAX/VMS V4.0

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